

U N C L A S S I F I E D



TASK ORDER 04

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LASER DISPLAY FEASIBILITY STUDY

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in reply refer to:

September 21, 1964

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Subject: Laser Display Feasibility Study Monthly Status
Report No. 3, [] Task Order No. 04

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PROGRAM STATUS AND PLANS

This Monthly Status Report No. 3 marks the end of the first quarter's work on this nine-month study program. Consequently, it is felt that a review of the accomplishments of the study to date and the plans for the remaining two quarters is in order. Such a review is the basis of this report; the format of the Statement of Work is used, as indicated by the headings which follow.

Literature Search

Literature searches in the areas of optical modulation techniques, scanning techniques, and display screen materials have yielded about 700 reference papers and documents to date. Pertinent references have been ordered, and the formal search has been stopped. Abstract journals, etc., will be reviewed once or twice more during the study in order to acquire any pertinent papers published subsequent to the conclusion of the formal search.

Light Sources Study

The output characteristics of the light source in any display system of the type under consideration in this study are of major importance. Consequently, the light sources study is being conducted on a continuing basis throughout the program. Both lasers and conventional light sources are being considered. Information is being accumulated, both through literature reviews and personal contacts. Information disclosed is being maintained in the form of notes, and will later be summarized in the form of a matrix for the purpose of comparing the characteristics of the many light sources of interest.

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Scanning Techniques Study

Another program, separate and distinct from the program reported here, was recently started at the [redacted] This separate program is concerned with display techniques, and is heavily oriented toward the problem area of scanning techniques. In order to permit maximum advantage to be taken of knowledge acquired on that program, work on the subject program of this report has been so scheduled that the study of scanning techniques will occur late in the program.

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Modulation Techniques Study

The papers acquired through the literature search on modulation techniques are in the process of being categorized by type of technique and cataloged for study. Each paper is being reviewed, and pertinent information contained in each is being extracted and put into a highly condensed form. A matrix (or chart) is being made, wherein each technique is listed in a vertical column along the left-hand edge of the chart, and the characteristics, potentialities, etc., for the techniques are listed as headings for other columns. This will allow a first-order comparison of the many techniques of interest.

In addition to the matrix discussed above, an analysis is being conducted for the purpose of comparing the most two promising modulation techniques for application in the present or near future. The two techniques are optical interference modulation and electro-optic (Pockel Cell and Kerr Cell) modulation. Equations describing the characteristics of each of these modulation techniques are being derived; from the equations parametric plots are being made of various pertinent modulation characteristics. Such plots or graphs will greatly facilitate system trade-off studies to be conducted later in the program.

The analysis of the interference technique is now essentially complete, and the analysis of the electro-optic technique has been started. The plan is to maintain the complete analyses (in the form of draft write-ups) in the project technical file, and summarize them in the Final Report. The resultant equations and graphs will serve as valuable design data in any subsequent system designs.

Screens Study

The screens study is scheduled to start during the next reporting period (in October). Papers and references disclosed during the literature search will be the basis of the study at the outset. Both passive and active screens will be considered.

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STATE-OF-THE-ART FOR OPTICAL DISPLAY TECHNIQUES

The ultimate goal of the study contract is to obtain adequate information to allow two display systems to be defined for the photo-interpretation application: (1) the optimum system possible within the present state-of-the-art; and (2) the optimum system to be expected for the future. In the light of these goals, the following observations relative to the present state-of-the-art for optical techniques for display are submitted.

Two modulation techniques have been developed to an operational stage: interference modulation and electro-optic modulation. The interference modulator, which is based on the use of piezoelectrically driven mirrors in a Twyman-Green type optical interferometer, can be built to reliably give bandwidths of up to about 10 Mc/sec. Bandwidths of more than 20 Mc/sec. have been obtained with the interference modulator, but much care is required in the fabrication of the piezoelectric crystals* which serve as the active elements. The upper limit for the interference technique is probably about 25 to 30 Mc/sec. The electro-optic technique, on the other hand, can be modulated at frequencies up to several gigacycles. However, even the smaller of these electro-optic cells have capacities of several picofarads. Consequently, large bandwidths with electro-optic cells present an equally difficult problem for the driving electronics. The comparative study of the two techniques, when completed, should allow conclusions to be drawn relative to the most suitable technique for a given bandwidth requirement. Bandwidth requirements for any particular application depend upon several factors. For most visual display applications, however, the bandwidths of interest lie in the 5 to 30 Mc/sec. region.

Another parameter of great importance to display applications is resolution or spot size. Spots smaller than 10 microns over a two-inch line in the focal plane have been recorded with off-the-shelf lenses. Spots of 6 or 8 microns may be possible with selected lens designs. Spots of 3 or 4 micron diameters will, however, require the design of special optics.

A wide range of techniques exist for producing an angular scan of a light beam. The techniques range from mechanical scanners to the more exotic techniques which employ physical phenomena such as diffraction, electron/photon interaction, the electro optic effect, etc. State-of-the-art scanners, at the present time, rely upon rotating mirrors. Development of non-mechanical scanners is continuing, however, and these more exotic techniques may supplant mechanical scanners in the future. The comparative study of scanning techniques to be conducted later in the study program is expected to indicate which of the non-mechanical techniques offers the highest probability of success as a competition for mechanical scanners.

* The best material found to date for use as modulator crystals is a lead-zirconium titanate ceramic.



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Administrative Status

The percentage of the total estimated engineering dollars for the contract expended as of 12 September 1964 is 9.2%.

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Here's the original plus
3 copies of monthly report - this
is a little more detailed
because it's the quarter



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